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ABSTRACT

A study was conducted to compare the relative effectiveness of interactive video (IV) and linear video (LV) as delivery modes for the acquisition of basic photography skills in an independent learning environment at the college level. It was postulated that a self-instructional, self-paced approach would be beneficial because of the wide diversity of photography skills and experience typically possessed by the students in the population. Using students enrolled in a teacher education program, participants were randomly assigned to either a control (N=64) or experimental (N=64) group and given a pretest covering key concepts incorporated in the videotapes. The control group was instructed via LV and the experimental group via IV. Students were given an alternative form of the same test (posttest) immediately following the treatment; in addition, an attitude test was administered which measured such items as rate of instruction, frustration level, technical problems, and motivation. Analysis of covariance was used to compare achievement of the control group with that of the experimental group. Results indicate that the IV group recorded significantly and consistently larger achievement gains than did the LV group. Students also preferred the interactive video approach over traditional instruction. A list of references completes the document. (JB)

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EFFECTIVENESS OF INTERACTIVE VIDEO IN TEACHING BASIC PHOTOGRAPHY SKILLS

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LAS VEGAS, NV. JANUARY 21, 1986

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Introduction

The introduction of a new instructional technology has historically been followed by immoderate claims about the impact and effectiveness of that technology. This has occurred with motion pictures, television and computer-assisted instruction. The latest extravagant claims are for interactive video; a medium that combines the processing power of a microcomputer with the visual and auditory strength of videotape or videodisc (Grabowski, 1984; Leveridge, 1979; Waldrop, 1983). As with other media, the early years of implementation are filled with extreme claims, inappropriate applications, and enormous promise.

Bold predictions about interactive video have been made, but few studies have actually been conducted to validate or refute these claims. A preponderance of the literature is based on anecdotal accounts and is often written from a stance of advocacy (Bosco, 1984). This study addressed the need for systematic research to measure the effectiveness of interactive video as an instructional tool.

Purpose of the Study

The major purpose of this study was to assess the effectiveness of interactive video in the teaching/learning process. More specifically, a comparison was made of the relative effectiveness of interactive video and linear video as delivery modes in the acquisition of basic photography skills in an independent learning environment at a college level.

A second impetus for the study stemmed from the wide diversity of photography skills and experience typically possessed by the students in the population. For many students who have no prior photographic experience, traditional group instruction proceeds too rapidly; for others with considerable experience, the instruction will often be repetitive. This diversity suggested the need for an alternative mode of delivery. The investigator postulated that a self-instructional, self-paced approach would be beneficial for both novices and experienced photographers.

Research Objectives

The primary objectives of this study were :

1. To determine if there is a significant difference ($p.<.05$) in achievement between students who receive instruction using an

interactive video mode and those using a linear video mode.
2. To determine if there are significant differences ($p.<.05$) in attitudes about the instruction between students using an interactive video mode and those using a linear video mode.
3. To analyze the factors which contribute to the difference in achievement between the groups.
4. To analyze factors contributing to the differences in attitudes between the groups.

Procedures

In this study, students enrolled in a teacher education program received instruction in basic photography skills in one of two methods. The control group (N=64) received instruction in an independent learning environment via a linear videotape (LV). The experimental group (N=64) also received instruction in an independent learning environment but via interactive video (IV). Interactive video refers to computer-controlled video which allows branching of the program for remediation or enrichment (Floyd,1980; Levenson, 1983; Troutner, 1982). The tapes were produced by the investigator and the content of both tapes was nearly identical.

Using a random number table (Borg and Gall, 1983), students were assigned to experimental and control groups. Participants then completed a 25-item written multiple-choice test (pre-test) covering key concepts incorporated in the videotapes. Subjects waited five to seven weeks before watching the appropriate videotape. Students were given an alternative form of the same test (post-test) immediately following the treatment. Analysis of covariance was used to compare achievement of the control group with that of the experimental group. The pretest was used as a covariate in order to adjust for initial differences between groups, reduce sampling error, and to give a more precise estimate of post instructional performance (posttest).

Participants also completed an attitude survey. This form offered insights into students' perceptions concerning the instruction. The written reaction form was measured on a five-point Likert scale, and related to such items as rate of instruction, frustration level, technical problems, and motivation. Significance of between group differences on individual items was tested using the Mann--Whitney U test, and ordinal consensus was measured using a Leik scale.

Results

Achievement

Results indicated that the IV group recorded significantly and consistently larger achievement gains than did the LV group. There was a difference in means between pretest and posttest scores of 29.70 (from 49.80 to 79.50) points for the linear group as compared to 35.81 (48.94 to 84.75) for the IV group (Table 1). The average difference of 6.11 points in favor of the IV group, is significant at the .001 level ($F=10.48$). The ANCOVA table (Table 2) shows a highly significant F ($p.<.001$), which indicates a low probability that these differences were due to chance.

Table 1

Comparison of Pretest, Posttest, and Adjusted Posttest Means

Group	Pretest Mean	Posttest Mean	Adjusted Post Mean	N	Gain	Gain Diff.
IV	48.94	84.75	84.95	64	35.81	6.11
LV	49.80	79.50	79.30	64	29.70	

Table 2

Analysis of Covariance - Treatment Effect

Source of variation	Adjusted Df	Adjusted SS	Adjusted MS	Computed F	Tabular F
Between Groups	1	1017.33	1017.33	10.48	3.90
Within (Error)	125	12131.62	97.05		
Total	126	13148.95			

Significance 0.0019

Summary of Attitude Results

As some researchers have noted, interactive video may prove to make more of a difference in attitude than achievement (Bosco, 1984; Yeany et al., 1980). Findings from this study support this contention.

Although the attitude survey cannot accurately produce an overall measure, it is possible to get a comparative profile of student's perceptions of each method by tallying survey responses. Of 28 items on the survey concerning the perceived effectiveness, dependability, and motivation of each method, 16 were found to have significant differences in Mann-Whitney U levels ($p. < .05$). Items with the largest significance levels generally also had the greatest differences in means; in fact the first nine ranks were identical for both ranking methods (Table 4). Twenty-three group means were higher for the IV

group, compared to 5 for the LV. On agreement levels, 21 levels were higher for the IV group compared to seven for the LV.

Examining the levels of significance and between group differences may be informative. Of the 28 items, 16 items were significant at the .05 level, and 11 of those items had a difference greater than .4 of a category, all except one of these means were higher for the IV group. These need to be considered with some caution. Five of those items involved questions which were substantially different for each group. These data would indicate that student perception was higher for the interactive video method than for the linear video method.

Of the 28 items, between group levels of agreement showed differences above .15 on six items, five favored IV and one the LV group. Of these six items, five also had a between group disparity in means above .4. Of the seven testing related items, two were above .15 in agreement differences, and both favored LV. Of 21 items which involved student's reaction to the same question, only two had differences in agreement levels above .15 (.19 and .15). This indicates great similarity in item agreement levels between groups.

Table 3

Sample of Attitude Question Data Treatment

5. While watching this program I felt challenged to do my best.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	1	5	51	7	
%	0	1.5	7.8	79.6	10.9	
Cum. %	0	1.5	9.3	89	100	
Likert Mean	4			Agreement	.89	
LV						
Freq	2	9	11	38	4	
%	3.1	14	17.1	59.3	6.2	
Cum. %	3.1	17.1	34.3	93.7	100	
Likert Mean	3.51			Agreement	.695	
Between Group Differences						
Likert Mean	.49			Agreement	.195	
z score	2.90			Significance	.002	

Discussion The difference in between group means on this item was considerable (.49) and highly significant (.002). It would appear that students felt more challenged, more consistently (agreement difference .195) to do their best with the IV treatment...

Table 4

Key Attitude Differences
Ranked by Degree of Significance

Sig.	Same Q.	Item #	Content	Diff	Diff Rank
.0001	N	15	computer questions helpful/ review questions would have been helpful	1.70	1
.0001	N	14	method of feedback monotonous/ liked a discussion after instruction	1.54	2
.0001	N	19	could have learned just as well without computer features/ would be better with review questions or simulation	1.5	3
.0001	N	12	usefulness of simulation/ examples of 27 different pictures	1.2	4
.0001	N	16	dreaded missing review question/ would be helpful to review sections	1.18	5
.0001	Y	13	enough control over rate and sequence of instruction	.93	6
.0002	Y	18	more interesting than traditional methods	.54	7
.001	Y	28	how long could work effectivly with method	.52	8
.002	Y	5	challenged to my best	.49	9
.003	Y	2	mechanical malfunctions	-.25	17
.005	Y	20	prefer method to tradtional instruction	.48	10
.007	Y	17	felt someone was engaged in conversation with me	.43	11
.01	Y	27	like to learn other subjects with method	.31	13
.02	Y	10	too much material presented	.37	12
.03	Y	11	"Gallery" sequence useful	.30	15
.03	Y	25	best approach to use for learning photo	.28	16

Key attitude differences concerned level of learner control, level of interaction, and preference over traditional methods of instruction. IV students indicated a substantial degree of agreement (high consensus level) on several factors including the following items:

* For learning about photography I would prefer IV to traditional instruction.
* IV made it possible for me to learn more quickly than traditional methods.
* In view of the time and effort I put into it, I was satisfied with what I learned via this method.
* I felt I had enough control over the rate and sequence of the material.
* The computer-related features (review questions and a picture taking simulation) were important in helping me learn.

Time efficiency was not increased with interactive video. The LV group all took 30 minutes to watch the tape, the IV group's time ranged from 34 minutes to 70 minutes with an average of 49 minutes.

Possible Reasons for Achievement Differences

Practice and Repetition: Many researchers have noted that practice and repetition facilitate learning. The interactive video method offered these attributes through the use of review questions, remediation of material, and options to review sections. One could argue that in large part the increased effectiveness of the IV system is due to the student getting an opportunity to first be quizzed on the material (questions in the IV program were different than those on the achievement test). Additionally, the picture-taking simulation offered synthesis of the information and an opportunity to apply the information.

Attentiveness: With linear video the viewer can "tune out" the program or become easily distracted. The interactive video program used in this study required mastery learning; if the viewer did not pay attention and kept missing review questions it would take longer to proceed through the instruction. It would appear that interactive video could help increase concentration for viewers with low motivation, however this may come at the price of increased anxiety and stress. Subjects in this study, for the most part, did not indicate that they dreaded missing a review question, in fact several students commented that they enjoyed the challenge, and the chance to review their understanding of the material before being tested.

High Level of Interaction: Many researchers have noted that participatory experiences aid learning. Anandam and Kelly (1981) noted that interactive video "changes the student from passive observer to active participant" (p. 3). However, Bosco (1984) cautions that just because interactive video requires the student to utilize a keyboard, equating motor response with active participation trivializes the notion of what is active and what is passive in learning situations. In some cases existing programs have become "interactive" by simply

adding menus or review questions. In this study, the program was specifically designed to incorporate a high level of interaction, including a simulation of taking a picture.

High Quality of Software: Ultimately the effectiveness of any medium will be determined by the quality of software utilized. This has been evident in the inability of educational films, television, and possibly CAI to reach their full potential. From student responses, it is apparent that there was a high level of satisfaction with the programs used in this study. By careful design both programs were nearly identical in approach and content. However, the interactive videotape utilized the attributes of computer-related features.

Possible Reasons for Attitude Difference

There were 16 significant attitude differences. For purposes of explanation these can be grouped into five main areas:

Level of Learner Control: Quite evidently one factor in the difference between groups was that the linear video group effectively had no control over rate or sequence of instruction, while the computer-related features of the interactive video system afforded that group some degree of learner control. Several IV subjects indicated that they would prefer greater control over program pacing, however 78 per cent of them either agreed or strongly agreed that they felt enough control. The issue of amount of control to offer the learner remains a controversial and important issue for designers and would make an excellent topic for further study.

Opportunity for Review Questions, Feedback, and Review Sections: The LV group indicated a high desire for opportunities for review and practice. This was the most commonly cited shortcoming of the linear video method. The IV group exhibited a high level of agreement that the review questions and review sections were helpful to them, and that interaction with the IV system was positive and reinforcing.

Preference over Traditional Instruction: The difference in preference of the method used over traditional methods (illustrated lecture) favored the IV group by .484 and was significant at the .005 level. This can be due to several factors. Certainly one factor is novelty; the concept of using a videotape recorder connected to a microcomputer was enticing to many learners. However, the Hawthorne effect may not be germane because data indicated that learning via videotape was also novel to most participants. Students in the population typically had more exposure to computers than instructional television. A more important factor might have been the interaction afforded by the computer. Research on CAI has shown that the holding power of computers is in large part due to the interactive nature of the technology. In this study, the IV group had a higher perception that someone was involved in a conversation with them while receiving instruction than did the LV group (difference .437, significance .007). It may be interpreted that the computer-assisted video instruction was

perceived as being more humanizing, individualized, and personal than did the linear system.

Challenge to do Best: The IV group felt more challenged to do their best while watching the program than did the LV group (difference .49, significance .002). It is believed that this can be directly attributed to the IV students needing to correctly answer review questions to proceed with instruction. As mentioned above, whether this is a trade off for increased anxiety is a concept worthy of further study.

Time Able to Effectively use the Method: It is interesting to note that each group felt they could work effectively with the method approximately the amount of time that it actually took to watch the program. For the LV group this was thirty minutes, and for the IV group the average time on instruction was about fifty minutes. It may be that students had the perception of being able to effectively longer work with the IV system because of being an active learner. In education it is a maxim that "involvement precedes interest", and this may have been the case in this study. It may be discovered that instruction may take longer with interactive video, but because learners are active and not passive, they can work longer effectively.

Implications for Further study

Retention: Achievement measures in this study measured only immediate recall of information. Testing took place immediately following treatment. A larger question would be the comparative effectiveness of methods in retention testing.

Cost-benefit, Time Effectiveness: Although this study demonstrated that interactive video can increase instructional effectiveness, it did not explore the issues of cost or time effectiveness. Interactive video is more complicated to produce than almost any other medium of instruction, and development and production costs are proportionally higher, typically as much as four times greater than CAI or linear video. However, the high development costs can be offset by repeated use of the materials and the automation of some instruction. Therefore, interactive video may be attractive to trainers who need to provide the same instruction to large number of persons at many different cites.

Increased station cost is also a drawback of interactive video. An interactive video system costs more than twice as much as a linear video system. This high station cost may make interactive video inappropriate for training or instructional situations where numerous stations are needed and funds are limited.

This study found an increase in instructional effectiveness of IV of about 17 per cent over LV. This increase may not be large enough in many situations to justify the added expense. Time on instruction was also higher for the IV group than the LV group, about 50 per cent higher. In many instances this may not be an acceptable trade off.

Attitude vs Achievement: Research in computer-assisted instruction

has indicated that CAI may make a larger difference in learner attitude than in achievement. This may also prove to be true for interactive video. This study did not compare the level of significance between the two different research questions. It may be that interactive video's largest benefit is not its instructional effectiveness, cost effectiveness, or time efficacy, but in its ability to motivate and involve students.

Factor Analysis: This study addressed the question of how interactive video compares to linear video in instructional effectiveness and student perceptions. A more focused question is why was interactive video more effective than linear video. This chapter has offered some insights into probable causes for differences in results between the two methods. These projections are based on: data from the attitude surveys, student comments, personal experience, and intuitive judgment. Research should be conducted to provide a formal factor analysis to assess the reasons behind the performance of interactive video. This could be accomplished by altering the design of interactive videotapes and testing single attributes of interactive video. Below are several aspects which could be varied to test for their individual effect.

Varying Learner Control: Throughout this paper the point has been reiterated that the amount of learner control to give students is a key issue for designers of interactive video materials. It would be beneficial to determine if there is a direct relationship between level of learner control and student achievement. This would have implications far beyond just interactive video instruction. With interactive video this level could be modified by offering students varying levels of control over program pacing, sequence, and feedback. Students could be offered more control over what method of instruction to use or whether review sections would be optional or automatic.

Varying Level of Interactivity: Another interesting question would be if there is a direct relationship between level of interactivity and achievement. By comparing programs with varying levels of interactivity the effect of learner interaction on achievement could possibly be isolated. Variable factors could involve comparing the use of review questions to the use of simulations, or the use of multiple-choice questions versus inquiry questions.

Group Instruction: This study examined only individualized instruction, yet interactive video may have some important implications for group instruction also. Field testing the materials utilized in this study involved comparing IV individualized instruction to IV used in a class environment. In the group instruction answers to questions were derived from a consensus of the group. A short amount of time was allowed for questions and discussion with the instructor. Although adequate controls were not maintained, this experiment did find that the mean for the IV group treatment was only four points lower than that for the IV individualized method. Given the cost and complexity of delivering individualized instruction it would be beneficial to compare these two different forms of delivery.

Mechanical Dependability: In this study nearly twenty per cent of IV students experienced at least some mechanical malfunction. For many training situations this would be an unacceptably large figure. Before large scale implementation of interactive video instruction is conducted it would be beneficial to determine the mechanical reliability of different systems.

Brevity of Instruction: Barbara Fowler (1980) in her doctoral dissertation noted that due to the brevity of instruction generalizations are limited to instruction of similar length. In her case, as well as this study, instructional sequences occurred over a 30 to 50 minute time span. Further research should be conducted utilizing instruction given under other time conditions.

Replicability: Research in the social sciences has often been criticized for its lack of replication. Interactive video has been especially susceptible to this. At the time of this writing only eight other dissertations on interactive video had been written. Interactive video offers a relatively facile way to replicate a study because the same materials can be reemployed. It would also be worthy of investigation to administer the same materials to different populations.

Different Populations and Subject Matter: Interpretation and generalization of results from this study is limited to data obtained from students enrolled in a teacher education program instructed in basic photography skills. Other studies should be conducted to determine the relative effectiveness of interactive video with different populations and with different subjects of instruction. It may be discovered that a particular medium is good at teaching some concepts to some learners and not good at others. This is an area of research that CAI research is just beginning to focus on.

Applications of Interactive Video: Determining the proper application of interactive video may be as important as investigating the relative effectiveness of the medium. As the research in CAI and instructional television has shown, proper design of software and wise application of the medium can be the decisive factor in determining the effectiveness of a technology. A relevant question is "Should we be using interactive video based instruction or interactive video assisted instruction?". Research on CAI has shown that computer-assisted instruction has been more effective than computer-based instruction. Indeed in this study, in which instruction was IV based, many students indicated the desire for discussion, hands-on experience, and live question-and-answer sessions. The attribute-treatment interaction could be studied to determine what kind of student learns best from interactive video. Additionally, the level of use needs to be explored. There are at least three distinct utilization levels: class level, unit level, and lesson level. Bosco feels that ultimately interactive video will be more beneficial utilized as learning modules rather than replacing entire courses of study.

Use in Conjunction with Other Media: In reality, most educators and trainers draw on a variety of methods and media. Studying an instructional technology in isolation is to some degree an academic exercise. Research should be conducted to determine the effectiveness of interactive video when used in concert with other media. Although it is difficult to conduct multi-variate research, it is essential that it be done because actual learning and teaching will ultimately be delivered in the real world of multi-sensory environments. Only then will interactive video be able to come out of the research lab and into the real world of training and education.

Conclusion

In this study interactive video was shown to be more effective than linear video in teaching basic photography skills to students enrolled in a teacher education program. Significant improvements were measured in both achievement and attitude. This study demonstrated that interactive video can be a very powerful and effective training method, given certain considerations. These considerations are essential issues in the effective use of the medium. Interactive video materials must be designed and produced to address the unique characteristics and strengths of the medium; it must be utilized effectively, converging the capabilities of the technology with the nature of the educational task; and it must be used in conjunction with other media and methods, taking into consideration the total learning environment and learner characteristics. Ultimately, it is the instructional methods that interactive video facilitate that will be the strength of the medium. In concluding, it is worth reiterating J.J. Bosco's advice to potential designers, producers, and users of interactive video:

> In order for the technology to be used effectively, we need to get beyond the statements of the first generation of advocates to more careful considerations. If interactive video is to become a useful tool in education, and not a mere toy or plaything, we need reasoned analysis as much as enthusiasm.

Hopefully this study will serve as a pioneering effort in the reasoned analysis of interactive video, and will aid in the transformation of the medium from technological plaything to educational tool.

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